RESEARCH ARTICLE

ASL Stories with Handshape Rhyme: An Exploratory Intervention to Support English Vocabulary with Signing Deaf Readers

Authors
Merrilee R. Gietz [1], Jean F. Andrews [2], M. Diane Clark [2]

Affiliations
1 University of Houston
2 Lamar University

Correspondence concerning this article should be addressed to:
Merrilee R. Gietz (corresponding author), Department of Communication Sciences and Disorders, American Sign Language Interpreting Program, University of Houston, 4455 Cullen Blvd, Room 100, Houston, Texas, 77204-6018. Email: mrgietz@uh.edu; Jean F. Andrews (co-author), Department of Deaf Studies and Deaf Education, Lamar University, P. O. Box 10113, 4400 MLK Blvd., Beaumont, TX 77710, Email: Jean. Andrews@lamar.edu; and M. Diane Clark (co-author), Chair Department of Deaf Studies and Deaf Education, Lamar University, P. O. Box 10113, 4400 MLK Blvd., Beaumont, TX 77710, Email: diane.clark@lamar.edu

ABSTRACT

An exploratory reading intervention using ASL stories, some with no visual handshape rhymes and others with handshape rhymes, to foster English print vocabulary was evaluated. Four signing deaf students, who were prelingually and profoundly deaf, between the ages of seven and eight years of age and reading at the first-grade level or below were engaged in the intervention. During group story time sessions, stories in American Sign Language (ASL) were presented on PowerPoint slides that included stories translated into both ASL and English, and short lessons using bilingual strategies. Using a pretest-posttest design, the print words were presented within ASL stories across three conditions; 1) with no ASL handshape rhyme, 2) with ASL handshape rhyme, and 3) with English word families (e.g., c<u>at</u>, s<u>at</u>, b<u>at</u>) that rhyme. Students' vocabulary scores were significantly higher on the ASL stories with handshape rhymes, marginally significant in the non-rhyming ASL stories, and non-significant in the ones with rhyming English word families. This finding points to the importance of rhyme for young deaf children attending ASL/English bilingual programs and suggests that creating ASL stories with rhyme can help to bootstrap English literacy. Future directions for research are recommended.

Keywords: vocabulary, word reading, bilingual, Deaf, visual sign phonology, handshape rhyme, intervention

Introduction

Vocabulary, a cornerstone for language learning, is a gauge for general reading development for both hearing (Zhang, Lin, Wei, & Anderson, 2014) and deaf students (Paul, 2009). However, deaf students are disadvantaged compared to hearing students as studies show their vocabulary size is smaller with minimal increases as they grew older (Traxler, 2000). Young deaf students also have limited depth to their vocabulary knowledge as shown by Coppens, Tellings, Verhoeven, and Schreuder (2011); here, hearing students obtained scored on grade level for their vocabulary knowledge while most deaf students scored at lower than their age-matched hearing peers. Additionally, when matched on minimal word knowledge, the deaf students demonstrated less word comprehension. The importance of both breadth and depth of vocabulary knowledge to the reading process was highlighted by Paul (2009, p. 288) who aptly wrote: "what skilled readers know about words is mind-boggling. Not only do they know a large number of words (breadth), but also, they have an in-depth knowledge of words, including multiple meanings, nuances, and figurative uses." As such, deaf students' lack of a broad and deep vocabulary knowledge severely curtails their reading comprehension abilities (Paul, 2009).

Factors in learning vocabulary

When considering deaf students, the acquisition of word knowledge is complex due to multiple background factors. It is well acknowledged that deaf students constitute a unique language learning population who vary widely in their use of language modalities (spoken, signed, or both), degree of hearing loss (severe to profound), use of hearing technology (i.e., hearing aids and cochlear implants), and access to proficient linguistic interactions (Spencer & Lederberg, 1997). While teachers cannot always control these background variables, they can manage instruction and tailor it to their own deaf students' backgrounds. In response to this heterogeneity within the population, researchers and teachers have designed specific instructional strategies. They have created a variety of interventions adapted to deaf students' language backgrounds, such as those designed for students with cochlear implants and hearing aids to examine the impact of spoken language phonological awareness on early reading (Cupples, Ching, Crowe, Day & Seeto, 2014; Miller, Lederberg, & Easterbrooks, 2013). Others have created early reading interventions that feature phonics to foster reading (Lederberg, Miller, Easterbrooks, & Conner, 2014). Recently, the Center on Literacy and Deafness at Georgia State University produced two evidence-based literacy curriculums, one developed for students who using spoken language (clad.education.gsu.edu/curriculum/; *Foundations of Literacy)* and another for signing students called *Fingerspelling Our Way to Reading.* These various interventions have been custom made for the different pathways that deaf students access language for reading success.

Alternative pathways to learn about vocabulary

There are also additional alternative pathways to reading for young deaf children who use sign language, including fingerspelling that have been developed (Allen, Letteri, Choi, & Dang, 2014; Andrews & Rusher, 2010; Andrews, Hamilton, Dunn & Clark, 2016; Andrews et al., 2016; Bailes, 2002; Crume, 2013; Haptonstall-Nykaza, & Schick, 2007; Herbold, 2008; Hoffmeister & Caldwell-Harris, 2014; McQuarrie & Parrila, 2014; McQuarrie & Abbott, 2013; Wolsey, Clark, & Andrews, 2017) . Why not positing a theory per se, these studies emphasize the role of sign language in reading with signing deaf readers. In view of these visual pathways, researchers have recognized a need to further examine these literacy processes because this

population brings unique language learning backgrounds to the reading process as well as facing challenges in accessing sign language.

Signing Deaf Children: Target Population

This sign-print intervention using ASL stories with handshape rhymes was designed specifically for signing deaf children. The precise numbers of signing deaf children who could plausibility benefit from sign-print vocabulary instruction is not known. Published statistics do show that within the deaf school age population, only about 5% are born into deaf families who are exposed to ASL from birth (Mitchener & Karchmer, 2004). Other sources report that most hearing families use speech as the primary mode of communication: 92.5% using spoken English and only 3.8% using ASL. This finding is similar with teachers as 52% of teachers use speech only, 34.9% use sign supported speech, while only 11.4% use only sign language (Gallaudet Research Institute, 2008). We also know that signing exposure varies widely as signing deaf children acquired ASL or an English based sign code on different timetables from early childhood to adolescence (Mayberry, Lock, & Kazmi, 2002). Signing deaf children also differ widely on measurements of their hearing acuity, speech perception and production, age of hearing aid fittings and implantation as well as the extent of training and use of technology— all of which affect literacy processes (McQuarrie & Abbott, 2008). They also differ on written and sign language skills. For purposes of this paper, the four deaf children targeted in the intervention are described as "emerging or developing bilinguals" who are prelingually deaf, have limited speech perception, and have profound hearing losses of 90db or higher. These students use both ASL and English in their everyday lives across a continuum that changes depending on their conversational partners (i.e., deaf peers or hearing family members) and environments (i.e., school, home, deaf sports and social

outlets; Andrews & Rusher, 2010). The four children, between the ages of 7 to 8 years, in this study fit into Grosjean's (2010, p. 148) category of "special bilinguals" who have many bilingual characteristics but are not as fluent as "balanced bilinguals" who are equally fluent in both languages.

Literacy and Language Challenges

In understanding the rationale for developing this sign-print intervention, it is important to see specifically how deaf students are challenged in learning to read, specifically in the area of vocabulary. Studies show that deaf students, on the average, leave high school with a fourth grade or below reading level (Traxler, 2000) with as many as 35 to 65% of school age deaf children not being able to meet their state's proficiency for reading in grades 3 to 8 (Easterbrooks & Beal-Alvarez, 2012). But looking beyond these frequently reported figures, one can see that early delays in both expressive and receptive vocabulary undergird deaf students' impoverished word reading abilities (Luckner & Cooke, 2010; Paul, 2009).

Compared to deaf children, hearing children acquire their spoken vocabulary quickly, and effortlessly, through daily encounters with caretakers. These hearing children learn about 10,000 to 14,000 words by age six (O'Grady, 1995). As they grow older, hearing children while listening to conversation or experiencing read-a-loud storybooks, acquire new words through incidental learning as they build on their knowledge of word families (Shu, Anderson, & Zhang, 1995). With such a storehouse of familiar words, students bring this knowledge to the recognition and analyses of unfamiliar words as hearing children harness their spoken language phonological awareness, an oral language skill. They then can develop an understanding of the predictable relationships between written letters and spoken sounds (i.e., the alphabetic principle; Vacca et al., 2012).

One strategy for word recognition that has been identified for early hearing readers is the use of word families (Johnson, 1999). A word family, also called a phonogram, is a group of words sharing the same spelling and sound pattern (Harris & Hodges, 1995). In word recognition, the task is to identify a sequence comprised of a vowel grapheme and an ending consonant grapheme as –*ed* in *red, bed, fed*, or –*ake in bake, cake, lake*. (Word family can also mean a group of words having the same root or base, as *publisher, publishing, unpublished, publication.* But this second definition for word families is suited for more developed readers; Harris & Hodges, 1995.) For beginning readers, the phonogram or word family is the study of onset and rimes. Take the word, *cat*, the onset is the initial consonant (i.e., c) and the rime being the vowel and the remainder of the syllable (i.e., -at). Johnston (1999) states that once the –*at* rime is visually and auditorily mastered then children can use analogy to read and spell numerous one-syllable words such as *pat, chat*, and *flat* as well as syllabic chunks in longer words as in *category, acrobat, and quadratic*. As such, children use this analog strategy to remember sight words, to decode unfamiliar words, and to spell words accurately (Ehri & Robbins, 1992; Goswami & Bryant, 1992 in Johnston, 1999). When teachers help young children to read rimes in words that appear more times than most other words on word lists or in stories (i.e., high-frequency words), this expands their word recognition skills into hundreds of new words (Johnston, 1999). Then knowledge of single-syllable rimes can further launch children into learning to read familiar syllabic chunks in multisyllabic words as *hippopotamus* which is made up of four rimes: -*ip, -o, -at*, and –*us*, thereby expanding their word recognition into thousands of words (Johnston, 1999).

The role of early phonological and orthographic awareness in hearing children's reading development has been well researched (Adams, 1990; Johnston, 1999). Beginning readers find it easier to learn to read by using rhyming phonograms. Adams (1990, p. 130) states the following:

…for immature readers, readers who have not yet acquired a set of associations to match the print before them, it is important that they not just look at the word before them but that they attend carefully to its complete ordered sequence before them.

When children attend to these ordered sequences of letters with similar sound and letter patterns they learn word families; this practice reinforces "the integrity of frequent spelling patterns even as they participate in different words" (Adams, 1990, p. 132). As such, the orthographic spelling patterns contained in word families are interrelated in memory (Seidenberg & McClelland, 1989 as cited in Adams, 1990, p. 132).

Still another strategy to build word recognition skills in both oral and written language is through alphabet books and rhymes, both of which help children hear beginning and ending phonemes (Mason & Au, 1990). Not to be confused with the word *rime,* its homophone the word *rhyme* is a word that sounds and can be spelled the same (qu*ick*, candlest*ick*), but a rhyme can also be spelled differently (e.g., *hey, may, lei*). Rhymes are commonly found in children's literature in nursery rhymes, decodable books, and predictable books. Nursery rhymes have numerous benefits, including: exposing children to hearing and imitating vowels and consonants (Kenney, 2005), providing children with patterns for words (Mullen, 2017) and supporting active prediction for upcoming words (Read, 2014). Decodable books give children practice with familiar phonetic elements found in word families and predictable books give children opportunities to practice familiar words and learn new words from familiar word family patterns.

It is important to note that signed translations of spoken rhymes and/or rimes in

English stories do not rhyme. However, if you fingerspell the words to deaf children, they can pick up the visual repetition of the letters and thus develop pattern recognition of letters. While the importance of teaching word families to hearing children has been documented, there has been little published research that tests its efficacy with deaf children. This situation may be changing soon as the Center on Literacy and Deafness (CLAD) state on their website that they support the use of fingerspelling of word families and are currently conducting research on this topic (https://clad.education.gsu.edu/curriculum/).

Additionally, young readers may also encounter new words incidentally in a text where they learn their meaning through context clues (Nagy, Herman, & Anderson, 1985). These context clues are often not accessible to deaf readers because many texts are too difficult to read and word meanings are not explicit enough for them to leverage this vocabulary to understood new word meanings, as do hearing children (Schirmer & Gough, 2005). Clearly, vocabulary must be explicitly taught to deaf students (Luckner & Cooke, 2010; Paul, 2006; Schirmer & McGough, 2005) which is a slow process which inexorably leads to lower levels of word knowledge.

But deaf children are not alone in vocabulary deprivation, as even hearing children from economically disadvantaged families experience approximately a 30-million-word gap compared to children from professional families (Hart & Risely, 2003). As such, this vocabulary gap has been termed the "early catastrophe" by Hart and Risely. However, deaf children's lack of exposure to incidental vocabulary learning is different from hearing children from economically disadvantaged families; these hearing children are exposed to lower levels of spoken language (which is fully accessible) while deaf children frequently do not have complete access to language.

For some deaf children, a spoken language delay can be offset by the introduction of an early signed language. Anderson and Reilly (2002) collected norms for young deaf native signers by using deaf native signing parental reports; their results showed that productive vocabulary learning progressed to approximately 500 signs by three years of age for these native signers. In contrast, Cupples et al. (2014) found that in their sample that deaf children who wore hearing aids (70.3 %) or cochlear implants (29.7 %) had much lower vocabulary levels, only producing four to 112 words by age five.

These gaps in word knowledge and incidental learning have been referred to as the *dinner table syndrome* (Hall, Smith, Sutter, DeWindt, & Dye, 2018; Meeks, 2017), which is related to the idea of "linguistic neglect" (Humphries et al., 2016) or the "language deprivation syndrome" (Hall, Levin, & Anderson, 2017). Here deaf children in hearing families frequently are unable to participate in ongoing conversations. Consequently, they have gaps in both vocabulary acquisition and their world knowledge, which ostensibly can lead to word reading deficits.

Signing, however, cannot be viewed as a panacea for vocabulary deprivation even with early sign support. Regardless of their language modality, deaf children may slip farther behind on vocabulary acquisition as they grow older due to factors such as a lack of incidental learning as well as a paucity of contextual word learning and weak reading skills (Paul, 2009). As a result, teachers are left to the teaching of language and reading at the same time (Musselman, 2000). Given that phonology is assumed to be necessary for reading comprehension (Perfetti & Sandak, 2000), it becomes important to look at phonology within both spoken and sign languages to understand how this phonology can lead to acquiring vocabulary and reading words.

Word Recognition Stages

Hearing children

Numerous studies of young hearing readers have underscored the importance that spoken language phonological knowledge plays in the development of early reading (Bryant & Goswami, 2016; NELP, 2008). Hearing children first learn to read words in print that they already know and use in their spoken communication. As they learn more words, they link their knowledge of sounds in familiar words to sounds in unfamiliar words using sound phonological awareness. This strategy leads to their understanding of the relationship between letters and sounds (i.e., the alphabetic principle).

Hearing children also learn to recognized words in phases. Starting at the *prealphabetic stage* (Ehri, 1991) (also called the *logographic stage*, Frith, 1985), they use visual cues such as recognizing words with pictures in environmental print (e.g., *McDonald's*) or recognize a word by its shape. During this initial stage, they are learning about the function of print (Mason, 1980). They then transition to the *partial alphabetic stage* recognizing some of the letters in the alphabet and using them to remember words by sight (Ehri, 1991). And as they learn about letter-sound correspondences, they guess at identifying the word, based on the initial letter (Mason, 1980). Moving into the f*ull-alphabetic phase,* children acquire knowledge of the grapho-phonemic system to decode unfamiliar words (Ehri, 1991). In the fourth or *consolidated-alphabetic phase*, children integrate their knowledge of grapheme-phoneme blends to form larger units that occur in simple and compound words (Ehri, 1991). Frith (1985) terms this last stage the *orthographic stage* as children analyze words into larger, orthographic units rather than phonological sounds.

Deaf students

Deaf children ostensibly arrive at the "gate" of learning to read with significantly reduced numbers of stored words in their mental lexicon (Anderson & Reilly, 2002; Cupples et al., 2014). Signing deaf children were found to progress through three levels of word learning during a longitudinal study conducted over one year at three schools for the deaf. The study consisted of 45 signing deaf children ages 5 to 8 in the kindergarten and first grade (Andrews & Mason, 1986). At level 1, children's fingerspelling, signing and print knowledge were limited. At this initial level, they were *letter-readers* as they were able to identify about 10 print letters, print some letters, and recognize familiar letters in words. At level 2, the children were *picture-context readers*. They were still oriented to letters as they began to fingerspell and print their first names, and names of family members, recite the manual alphabet, and print most of their letters. Parents observed their children fingerbabbling random letters during play, and frequently pointing out letters of the alphabet on road signs, food labels and books. But pictures became important too as they had an ability to recognize some words in picture contexts such as *McDonald*'s and *Trix*. Children had the concept that a word could be expressed in a sign and would often ask an adult to sign a word they could not read. Related to story knowledge, while they could recall a few content items, they could not sequence them accurately. At level three, the children were *graphic organizer-readers* where they integrated their word meanings into their sign language vocabulary. They acquired 15 or more sight words, could identify and print all 26 letters of the alphabet, and could fingerspell and print short three-letter words. Their word recognition errors showed they understood words could be broken down into letters and they focused on the initial letter. Related to story knowledge, they could recite back most of

the content items of simple stories in correct sequence (Andrews & Mason, 1986).

Given these profound differences in the quantity of deaf children's "mental word banks" compared to hearing children as well as alternative pathways in their word recognition stages, two major views related to how deaf children learn to read have been proffered. One view, called the *Qualitative Similarity Hypothesis (QSH),* hypothesizes that deaf children go through the same process as hearing children do but at a delayed rate (Paul, Wang, & Williams, 2014). The second view is that deaf children can learn to read using alternative pathways than hearing children, and instead utilize their sign language and fingerspelling (see reviews in Andrews, Hamilton, Dunn, & Clark, 2016). Central to this second view is understanding sign phonology, or ASL phonology, and its role in acquiring ASL signs and reading English words.

Sign phonology and its role in early reading

Linguists tell us that similar to spoken languages, ASL has a phonology or sub-lexical parts but it is not sound based. In 1960, when Stokoe provided a scientific linguistic description of ASL, he coined the terms cherology and chereme (based on the Greek word for hand) to label the sub-lexical parts of ASL that include: handshape, location, movement, and palm orientation. Later, ASL linguists dropped Stokoe's terms, and instead used the term ASL phonology (Valli et al., 2005) or phonology in the visual modality (Petitto et al., 2016). With further developments in ASL linguist research, scientists expanded the phonological (i.e. sub-lexical) structure of ASL as being composed of five parts: handshape, location, movement, body position and non-manual signals (NMS; Valli et al., 2005). So today, in the context of ASL linguistics, we use the terms visual phoneme and sign phonology to designate the sub-lexical parts of ASL. The underlying concept of phonology is the same for both

spoken language and sign language, that is, sound phonemes in spoken languages or the visual phonemes in sign languages combine in rule governed ways to form morphemes, words, syntax, and pragmatics (Brentari, González, Seidl, & Wilbur, 2011).

To clarify, the concept of *sign phonology* or *ASL phonology* is referred to by a variety of terms. The acronym *ASL PA* is used by Corina, Hafer, and Welch (2014) to refer to the phonological processing of American Sign Language. Brentari et al., (2018) call this *sign language phonology* and expand the definition to comprise the linguistic phenomena such as the syllable, the phonological word, and the higher prosodic units, as well as features such as timing units, and autosegmental tiers. Another term for sign phonology is *visual sign phonolo*gy or *VSP*, a nomenclature used by researchers at the Visual Language Learning Lab (VL2) at Gallaudet University. According to these researchers, VSP represents more than the five phonological parameters of ASL mentioned above, rather it includes orthography (letter patterns), rhythmic and temporal patterns, sign syllable structure, hand articulatory gestures, mouthing (called ASL mouth morphemes) and fingerspelling (Pettito et al., 2013; Petitto et al., 2016). Taking a similar tact, at a reading conference in San Sebastian, Spain, McQuarrie and Enns (2018) use the term, *signed language phonological awareness* to designate the analogous processes found in spoken language, *spoken language phonological awareness* (McQuarrie, personal communication, December 6, 2018). With this terminology clarified, we return to our discussion of how sign phonology impacts learning to read English.

While sound phonology (or spoken language phonological awareness) and its implications for the teaching of reading to hearing children has been well-researched in its implications for early reading (see NELP, 2008), the use of sign phonology and how it serves the same purpose of supporting English

reading is a new line of research. For example, using the tools of neuroscience, Petitto et al., 2016 hypothesize that early sign language provides deaf children with the capacity to segment the linguistic stream, categorize it, and discern its patterns through sign-phonetic and sign-syllable units and patterns, in addition to fingerspelling and mouthing patterns. As such, they hypothesize that VSP facilitates deaf children's development of mappings with English phonological, semantic, and orthographic representations through VSP exposure or VSP-based instruction (Petitto et al., 2016).

In a similar vein, McQuarrie and Enns (2018) hypothesize that making the phonological patterns of ASL explicit to deaf children aids in the organization of signs in their mental lexicon; this organization then enhances their ability to make sign to print connections. As such, these researchers refer to deaf children as using their *signed phonological awareness* in order to build a *"sign-symbol aptitude"* which they hypothesize is parallel to hearing children using their *spoken language phonological awareness* to build their *"sound-symbol aptitude"* (i.e., alphabetic principle; McQuarrie & Enns, 2018). Given these parallel systems, in this next section, the sign-print intervention research is reviewed.

Sign-Print Intervention Research
Deaf bilingual learners

McQuarrie and Abbott (2014) studied 50 bilingual deaf children, between the ages of 7 to 18, in Canada and investigated their awareness of ASL phonological structure and the relationships between ASL phonological awareness (ASL-PA), written English word recognition, and reading comprehension skills. The results showed that there was a significant difference in deaf students ASL phonological awareness and their discrimination increased as they grew older and became better readers. They also found "evidence of rich metalinguistic knowledge that children with

developing L1 phonological skills bring to the acquisition of L2 reading skills…" (p. 80).

The teaching of ASL handshapes to foster the learning of sign vocabulary was reported to provide a scaffold for learning printed words by Bailes (2001). She interviewed teachers and conducted classroom observations in elementary reading classrooms, observing that teachers provided instruction that linked similar ASL handshapes to ASL vocabulary, which became a bridge to recognizing English printed words.

Deaf children using ASL phonology, specifically ASL handshapes in their writing, were observed in two classroom using quasi-experimental early reading studies (Andrews et al., 2016; Wolsey et al., 2017). They utilized a method of shared book reading, called adapted little books, which follows a curriculum that included both signing stories in ASL as well as reading them in English print. In both studies, the children's drawings included using ASL phonology to label their drawing, which showed how signing deaf children connected their understandings of English print to visual sign phonology (e.g., ASL handshapes). During the first year-long feasibility study (Andrews et al., 2016), one child wrote the alphabet letters, UU on his paper and explained it to the teacher as meaning TRAIN (the handshapes UU signify the sign for train). Here the child transferred his segmentation skills to make the UU handshapes to making the printed letters U and U. The follow up study found increasing use of visual phonology to label drawings at the end of the intervention period (Wolsey et al., 2017). Also observed in this study was a "manual alphabet principle" (Wolsey et al., 2017). Deaf students used a tactile rhyme to replace the ABC song. When writing their ABCs, deaf students would start with A and write letters sequentially, until they could not remember any more letters. When students could not remember the next letter, they would go back and start over with signing the handshape for the letter, A, look down at their fingers and sign

the alphabet to themselves, to pick up from the last letter that they had written. Using the "manual alphabet principle" to sequence ASL handshapes to support writing of the English letters reflects aspects of their sign phonology as defined above (i.e., the sequencing of orthographic letters and fingerspelled handshapes, Petitto et al., 2016).

Direct teaching of ASL phonology was documented by Pizzo (2018) for deaf children enrolled in classrooms using a bilingual approach. Pizzo conducted a qualitative case study of vocabulary instruction of four early childhood teachers of deaf children (TODs) in two classrooms. One teacher developed ASL phonology teaching materials, such as a color-coded diagram, to show children how to identify ASL handshape locations by head, chin, and chest. The researcher reported that the two teachers used instructional modeling of ASL, including the following; direct teaching of signs, a focus on classifiers, exposing the children to ASL poetry, using fingerspelling for English words that did not have signs, as well as assisting the children in making sign-to-print connection. Consequently, it appears that sign phonology is an effective strategy for deaf children in learning more signs and to transfer this knowledge to reading English words.

Research Questions

The research question was: When deaf children are exposed to novel English words embedded in ASL stories, is there a significant difference in word learning for ASL stories presented in three conditions:

1) ASL stories using handshape rhyme versus stories;
2) ASL stories with handshape rhyme;
3) ASL stories with English rhyme and word families?

The rationale for inclusion of English word families in our intervention was to test whether presenting words in stories with repeated orthographic letter patterns would lead to increased word learning in contrast to ASL stories with handshape rhyme and ASL stories without handshape rhyme.

Method
Participants

Four prelingually and profoundly deaf students participated; their ages ranged from seven to eight. Three students were in the first grade and one child was in the second grade. All were reading below the first-grade level as assessed by Brigance Development III (Brigance, 2013) and the Qualitative Reading Inventory 5 (Leslie & Caldwell, 2011). Two were diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Of the four students, one had a deaf mother, three were boys, and one was a girl. To protect confidentiality, children are not referred to using their real names. The names selected were Andrea, Don, John, and Casey.

Early language and communication history. Andrea, Don and John were born deaf into hearing families. Based on school records, the children were identified as deaf at age 2 and began early intervention through the Texas Early Detection and Intervention (TEHDI) program. While TEHDI implemented newborn hearing screening in hospitals since 1999 through the passage of House Bill 714, it is not known why these three children were identified but not were not served until toddlerhood (https://texasdeafed.org/topics/newborn-hearing-screening). School records did reveal that a parent-educator with training in special education visited the homes one day per week and worked on basic communication and social skills using play activities with a focus on spoken language development. However, when Andrea failed to develop spoken language, she was introduced to sign supported speech at age 5 when she entered kindergarten. Don and John had difficulty learning spoken language and were introduced to sign supported speech when they entered preschool

at age 4. Casey was born to a deaf mother who
used ASL in the home from birth. See Table 1
for background information.

Table 1: *Background Variables of Four Participants*

Background Variables	Andrea	Casey	Don	John
Age in Years and month at time of data collection	7:10	8:11	7:1	7:11
Gender	Female	Male	Male	Male
Ethnicity	African-American	African-American	African-American	Caucasian
Hearing Loss	Bilateral profound	Bilateral profound	Bilateral profound	Bilateral profound
Hearing Aids	Yes, she wears it on her right ear only.	No	Yes	Yes
Cochlear Implants	Yes, she wears it on her left ear only.	No	No	No
Age when identified as deaf	Age 2	At birth (3 days)	Age 2	Age 2
Etiology (cause of deafness)	At birth- unknown	Lost his fluid	Possible heredity	Ear infection
Mother's occupational status	Yes	Yes	Unemployed	Yes
Father's occupational Status	Unknown	Unemployed.	Unknown	Yes
Early Intervention	Yes	Yes	Yes	Yes
Non-verbal IQ	84	80	105	92
Reading test score	PK	PK	K	K-1
Grade level	1st grade	2nd grade	1st grade	1st grade
Communication used at home	Signed English and American Sign Language	American Sign Language	Spoken English and gestures	Spoken English, minimal use of sign with spoken English
Communication used at school	Total Communication	Total Communication	Total Communication	Total Communication
Presence of any other disabilities	No	No	ADHD	ADHD
Age when first exposed to sign language in early intervention program	Age 5	At birth	Age 4	Age 4
Parents: Hearing or Deaf	Both parents hearing	Mother deaf; father hearing	Mother hard of hearing; father hearing.	Both parents hearing.
Age when first exposed to listening and spoken language in early intervention program	No speech	No speech	Age 5	Age 2

Teacher use of communication, language and materials. The students used both ASL and Total Communication at the school and were exposed to an eclectic language arts program that included a variety of materials including; basal readers, a phonics curriculum, the state reading curriculum, children's literature, pictures, charts, movies, YouTube videos, and internet visuals. The students used a variety of communication methods, including; spoken language, speech reading, ASL, and total communication. Reading instructional techniques included; visual phonics, lipreading, and spoken language. Their teacher was hearing and fluent in ASL and reported she often used fingerspelling and bilingual strategies, including; chaining, ASL expansions, and codeswitching throughout the day when the children were having difficulty comprehending a concept.

Research Design

A pre- post-test design was used to investigate the impact of ASL handshapes on vocabulary learning. The three conditions in the ASL story intervention were the following: 1) stories that include words with no ASL handshape rhyme, 2) stories that included words with ASL handshape rhyme, and 3) stories that included words consisting of English word families.

The design included 31 stories developed for the three conditions. The intervention was included in daily reading lessons for struggling deaf readers in a classroom that used a combination of Total Communication, ASL, and spoken English, depending on the lesson. Blocks were a week long. There were two blocks for stories with no handshape rhyme and two blocks for stories with handshape rhyme. The final block included stories based on English word families (i.e., c<u>at</u>, s<u>at</u>, b<u>at</u>).

The researcher created the ASL and English stories by first selecting vocabulary words from pre-primer, primer, and grade one vocabulary lists from Johns (1997, p. 132-133). Each story has five to eight sentences and contained four to five words (adapted from McCormick & Mason, 1990, "Little Books" series). Each story had a beginning, middle and end; hence, this structure formed a simplified story grammar (Stein & Glenn, 1979). All stories were presented in both ASL and English.

ASL stories with no handshape rhyme (n = 10) were composed of words that had diverse sub-lexical structures but no ASL handshape rhyme. For example, an ASL story with no handshape rhyme is the following: Title: *The Book. The girl goes to school. She reads the book. Time to go home. The girl forgets her book. The girl runs back to school. Get the book!*

Then next set of ASL stories (n = 13) were composed of vocabulary that had similar handshapes (i.e., open "5" handshape, clawed "5" handshape, tight "5" handshape, open "3" handshape, "Y" handshape, and "F" handshape) and labeled ASL stories with handshape rhymes. For example, an ASL story with handshape rhyme is the following: Title: *Fall. Tree. The leaves fall from the tree. The leaves are colorful. A leaf is falling down on the ground. Leaf pops up. A bird flies away.* This story had the open 5 handshape repetitions.

The final group of ASL stories (n = 8) were composed of vocabulary that were based on English word families (i.e., -at, -in, it, -ig, -et, -ip, -ug, and -en.) For example, within our intervention, one group of ASL stories were constructed with words that constituted English print word families, such as the following story which repeats the word family *-et*. Title: *My Pet. I have a pet. I feed my pet. I get my pet wet. I let my pet go for a walk. I let my pet get wet. Do not fret. We will go to the vet.* It is important to note that when this story, as well as others with word families, is translated into ASL, there is no rhyme, either auditory or sign rhyme. When the experimenter fingerspelled

the words, the child would see the similar letter patterns or rimes.

The stories were created by the experimenter and her assistant. Drafts of the stories were reviewed by a panel of two to three Deaf graduate students. The review panel originally consisted of three first-year students enrolled in a doctoral program with an ASL and English bilingual philosophy who were participating in a seminar on psycholinguistics. Based on their feedback, revisions of the stories were made. There were no illustrations in the stories.

Materials and Procedures

After obtaining permission from the Institutional Research Board (IRB), the parents, and the school, the researcher scheduled a one-day training session for the teacher where she demonstrated the 31 PowerPoint presentations on a DVD of the lessons. The researcher taught the teacher the steps to carry out the reading lessons. The ASL story intervention was incorporated into the teacher's regular literacy teaching. The teacher conducted the interventions and administered the pre- and post-tests.

For the pre- and post-tests, the words were placed on index cards and each child was tested on these words. The pre-test was given to the four subjects before they started participating in this study. On the pre-test, the teacher showed them the print words individually; if the child correctly responded with the sign for that word he/she was given one point.

Each of the 31 stories was displayed on a separate PowerPoint with eight to ten slides each. The researcher videotaped herself as the ASL story signer for all the materials. Five stories were presented each week, each taking approximately 20 to 30 minutes. These 31 stories were presented over the five-week time frame. The themes and content of the stories were based on topics familiar to first graders, such as animals, toys, food, games and family

relationships, which tapped into the children's prior experience and background knowledge (Anderson, 1984).

The instructional technique had four parts. First, the teacher showed the group of four children the slide where she signed the title and then signed the complete story in ASL. In the second step, moving to the next slide, she signed the first sentence in ASL. She stopped at the target word (in this case, book), fingerspelled it (B-O-O-K), using codeswitching techniques she expanded its definition by giving examples, then chained the word with the fingerspelling and the print on the slide (Andrews & Rusher, 2010). She then proceeded to the next slide and did the same procedure. This procedure was repeated for each story across the intervention.

The intervention was carried out over a five-week time frame, with types of words alternating within the ASL stories over the weeks. The structure of the intervention was that during the first week, five stories were taught that had <u>no ASL handshape rhyme</u>. During the second week, eight stories were taught <u>with ASL handshape rhyme</u>. Then in the third week, five new stories with no handshape rhyme were taught during reading, followed in week four by eight stories using <u>English word families</u>. The final week included five stories that had handshape rhyme.

Each lesson followed a specific plan; each day for 15 to 20 minutes, the teacher introduced one lesson, which contained 11 to 15 slides. The children viewed the stories in a group. They sat on the floor and watched the PowerPoint with movies as they were projected on a SMART board. For instance, during week one, she showed five stories with the corresponding PowerPoint lesson. In week two, she showed another five stories with the corresponding PowerPoint lessons.

After each story, the child was individually given a list of the individual target words for that particular story. For example, *The Book* story (presented in ASL with no

handshape rhyme) had 6 target words: *girl, home, forgets, school, read and book*. The teacher showed the child each printed word individually. If the child correctly identified the word on the word card, then the child received one point. Points were calculated in this way for each of the 31 stories. The teacher also made note of correct and incorrect responses and documented word recognition errors. When a student was absent, they were shown the story during the week when they returned.

Data Analytic Plan

Pre-test and post-test scores were used as the data in paired t-tests. Three different tests were conducted; one on the scores for the no ASL handshape rhyme stories, one on the scores for the ASL handshape rhyme stories, and one on the scores for the word family stories. Alpha was set at .05.

Results

To examine gains from pre- to post-test, numbers of words correctly identified using descriptive measures were utilized. To address the research question on the differences of word learning within the three ASL stories, three paired t tests were conducted with the dependent variables reflecting changes in the vocabulary scores across the three conditions (no ASL handshape rhyme, ASL handshape rhyme, and ASL stories with English word families). Means and standard deviations are in Table 2.

Table 2: *Means and standard deviations on the pretest and posttest scores across conditions*

	Pre-test M (SD)	Post-test M (SD)
ASL No Handshape	7.25 (11.41)	14.75 (11.62)
ASL Handshape	4.25 (5.97)	10.50 (9.26)
English Word Families	3.00 (4.08)	5.25 (6.70)

Comparing all three conditions, the ASL handshape rhyme story intervention was the only condition with a statistically significant change score from the pre-test to the post-test (t (3) = -3.24, p = 0.048). This finding is in comparison to the change score of the no ASL handshape rhyme story condition from the pre-test to the post-test (t (3) = -3.13, p = 0.052). The ASL stories with English word families also did not show a significant increase in vocabulary knowledge (t (3) = -1.57, p = .22).

Discussion

ASL stories with handshape rhyme increased word knowledge more than stories without ASL handshape rhyme or those ASL stories that used English word families; however, the increase between ASL stories with and without rhyme was much smaller than the difference between stories with ASL rhyme and English word families. It appears that students capitalized on this one aspect of sign phonology to bridge to their learning of printed words. This finding is consistent with Crume's

(2013) interviews with teachers who reported that deaf students learned new words using similar handshapes. It is also consistent with Bailes (1998) ethnographic study, in which she documented how one teacher used ASL handshapes to teach new English vocabulary words.

While words in the treatment of stories using the English word families were also signed and fingerspelled, the change scores in word recognition did not increase significantly. This finding may be explained by the fact that these children's fingerspelling skills were not yet at the analytic stage where they could take advantage of repetition of word family patterns or that the stories followed more of an English grammatical structure. This result is consistent with the findings of Padden (2006) who found that children learn to fingerspell "twice" first as a gestalt or whole, then later they learn to produce a linear string of hand configurations that represent individual letters of the alphabet.

The four children were unable to use the sound phonology found in the rime and rhyme sequences in word family stories as seen in their responses in their word recognition pre- and post-tests. This effect is consistent with Andrews and Mason (1986) who found that during word recognition tasks the deaf children were not processing print using sound in terms of initial, then initial plus consonant sounds as do hearing children when they begin analyzing words. Instead, they appear to be viewing words as linear strings of visually distinguishable letters. This finding is also consistent with the studies that found that deaf adults and students did not use sounding out strategies in recognizing and reading words (Freel et al., 2011; Mayberry, Del Giudice, & Lieberman, 2011; Miller & Clark, 2011; Mounty, Pucci, & Harmon, 2013). That the four young deaf readers were not able to use auditory rhymes or visually take advantage of the repetition of letters in the word family stories suggests that deaf students might benefit from fingerspelling lessons to help them focus on each letter in the word instead of just focusing on the first letter as many of the children's errors in the word recognition tasks demonstrated. Of course, these fingerspelling lessons of English word family vocabulary should not be presented in isolation but presented in the context of stories that the signing deaf child can understand using ASL first.

In contrast to sound phonology, sign phonology provided a structured decoding strategy that was more accessible through the handshape rhymes. Given the limited vocabulary of these four students at the beginning of the intervention, the findings suggest that this type of intervention has potential; it appears that sign phonology in conjunction with simple stories that include handshape rhyme can potentially be incorporated in a curriculum that can scaffold young deaf readers who are seriously delayed in their word reading abilities.

Related to the background variable of non-verbal intelligence, two children scored in the low average range (80; 89) and two in the average range (90; 109). Interestingly, the child who scored in the low average IQ range (80) made the most gains in word recognition (60 words). This child had a Deaf mother so early language exposure to signing from birth may have provided a language foundation for print acquisition. Another child with a low average non-verbal IQ (84) increased her word learning to 14 words. The child with an average non-verbal IQ (92) learned 35 new words; the child with IQ (105) learned only 7 words. However, non-verbal IQ did not make an impact on word learning as the four children were in similar ranges from low average to average.

Two of the participants were diagnosed with ADHD which makes word learning difficulty for some children. However, both boys made gains in word recognition, 7 new words for one and 35 new words for another boy. Both boys had average non-verbal IQs (105; 92). The two other children without

ADHD learned 14 and 60 new words respectively. Using the ASL handshape rhyme stories suggests that this intervention may have potential to be used with a wider group of deaf students who have learning difficulties such as ADHD as well as other secondary disabilities (Gallaudet Research Institute, 2013). Therefore, it is important to develop a literacy curriculum that is effective and includes these children as well.

Handshape rhymes stories are an integral part of Deaf culture and ASL literature, which historically had its beginnings in residential schools through ASL storytelling (Peters, 2000; Valli et al., 2005). Today, Deaf youth continue to create and perform their handshape stories on YouTube and other social media outlets. These examples, as well as the examples of ASL handshape rhyme and other ASL poetry available, both commercially and through social media, can provide a corpus for teachers to use within their reading curriculums.

Fingerspelling was also included in the handshape rhyme intervention. As such, fingerspelling appears to be the bridge that connects ASL to English print. This effect is consistent to the findings of Haptonstall-Nykaza and Schick (2007) who found that deaf children learned more vocabulary with lexicalized fingerspelling signs that exploited the repetition of similar handshapes. Results are also consistent with findings by Andrews and Mason (1986) and Hirsh-Pasek (1987) who found that fingerspelling is an important tool in learning vocabulary.

Using ASL handshape stories in the reading classroom may require an epistemological shift in the field for this idea to be integrated into bilingual classrooms with more Deaf teachers (Hauser et al., 2010; Holcomb, 2010). Currently, handshape walls are common in these bilingual schools as described by Crume (2013) in his teacher interviews. ASL nursery handshape rhymes are taught to parents in early intervention programs with deaf infants and toddlers (Andrews & Baker, in 2019; Holcomb & McMillan, 2014; Holcomb, 2018; Snodden, 2011). As such, the handshape rhyme provides a strategy to teachers that provides another vocabulary teaching tool to map meaning using their ASL onto English print and learn language segmentation skills.

Deaf adults tend to intuitively share these types of strategies with deaf children. Using ASL handshape stories may be a strategy that can overcome the need to explicitly teach vocabulary (Schirmer & McGough, 2005) to allow deaf students access to content. This strategy may have potential to increase incidental learning by providing deaf readers a decoding skill where they can use context to build meaning within a story grammar. A recent study (Holcomb, 2019) intentionally included ASL handshapes in a single-subject design to evaluate its impact on word learning. When initially compared to ASL stories without handshape rhyme no difference was found, similar to the findings that showed improved vocabulary learning in both story types in this study. However, by adding explicit instruction in how to engage with ASL handshape rhyme, children's word imitation improved. Holcomb's findings together with these findings suggest that without prior experience within deaf families, the benefits of this technique may be muted. Regardless, the type of intervention appears to be a promising one for deaf children with lower levels of vocabulary.

Our findings support the Alternative Frameworks view of reading that posits that signing deaf children use a different avenue and strategies to learn vocabulary print compared to hearing children. Specifically, the teaching of reading to bilingual signing deaf children entails emphasizing visual strategies, including sign language particularly visual sign phonology as a support for learning English printed words (Andrews et al., 2016). The four children were at level 3 *graphic organizer-*

readers where they integrated their word meanings into their sign language vocabulary (Andrews & Mason, 1986). The data also supports Hoffmeister and Caldwell-Harris's (2014) three-stage model. Starting with a visually accessible language allows for the mapping of sign to print through sign phonology. Using signs and sign phrases to link to English words and phrases was also developed as a bilingual approach using the Fairview method (Ausbrooks-Rusher, Schimmel, & Edwards, 2010). Our results are also consistent with Andrews et al. (2017) as well as Wolsey et al. (2018) who found that these struggling deaf readers included sign phonology in their drawings after viewing and reading stories presented in ASL and in English. This route provides teachers with insight into children's thinking and a strategy to help them point out the connections between meaning through signs, including visual sign phonology, and print.

Summary, Limitations and Future Research

This study, which is exploratory in nature, was an attempt to begin developing reading strategies for deaf children who use sign language. As such the intervention had three groups of stories presented in ASL with lessons using bilingual strategies of chaining and ASL expansions. One group of stories had ASL handshape rhyme; another group had ASL stories with no handshape rhyme and a third group of stories had ASL stories with English word families in its English translation. In any attempts to explore new ideas, limitations can surface after the study. We describe these limitations and then make suggestions for future research.

For one, the number of participants that were included in our study is low, comprised of only four children. As such, our findings could not be generalized to a larger population and only can be attributed to these four cases. Replication would be needed

studies would confirm or deny these findings. Secondly, the intervention was brief as students were presented each story only one time. Repeated presentations may increase the effectiveness of not only the ASL handshape rhymes, but the other two conditions of non-handshape rhyme and word families (see Cannon, Fredrick, & Easterbrooks, 2010 for use of repeated readings as an effective word learning strategy).

Third, while pre-test and post-test designs are widely used in behavioral research, there are inherent limitations that threaten internal validity. As such, the methodological appropriateness of measuring change in terms of mean change score could be questionable because it is not clear if one method (i.e., English word family method) which yielded a lower mean gain score was uniformly inferior to the other two methods across all of the stories (i.e., ASL handshape versus ASL no handshape stories; Dimiter & Rumrill, 2003). Further, the data analysis included three unrelated t tests, increasing the potential for overestimating the effect.

Given that the deaf boy with a Deaf mother (Casey) made the most gains in vocabulary suggests that having a stronger ASL base may have led to his easier time in increasing his vocabulary using all three conditions, as they were presented in ASL (Anderson & Reilly, 2002). Future studies could use a larger sample of deaf children from deaf families. His contribution to the data may also be the reason that all ASL stories showed improvements in vocabulary, even if the ASL handshape stories reflected a significant change while the ASL stories without the rhyme were marginally significant.

The significant finding in this project suggests that it may be worthwhile to develop a larger intervention for bilingual classrooms with more children to increase statistical power that can link handshape rhyme to both sign phonology and fingerspelling phonology. Therefore, future research should intentionally

introduce ASL handshape rhyme within the context of stories to help deaf children understand how to increase their sign vocabulary but also to learn to segment signs, then letters, to analyze new words. Research on using word families as a teaching strategy can also be addressed if they are presented in ASL stories with follow up lessons that helps children fingerspell the complete linear sequencing of letters. Care must be taken to ensure they understand the meaning of the new word and are not just fingerspelling as a placeholder (Ewoldt, 1981) or using "word calling strategies" where they can fingerspell word but are not able to express the meaning of the word. If a more intense intervention is determined to be effective, larger interventions should include readers who are reading at grade level as well as those who are delayed in their reading. The comparison of these two groups may provide insights into more effective strategies to scaffold signing deaf readers who can leverage their existing ASL and English skills in developing a stronger language foundation in both languages.

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